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## NEW POLYCHÆTA FROM CALIFORNIA.

BY J. PERCY MOORE.

Some Polychæta gathered by Mr. E. C. Starks, at San Diego, California, were recently sent to me for determination by Prof. Harold Heath, of Leland Stanford, Jr., University. Besides the eight herein described the collection includes about thirty species, most of which have been recorded from the Pacific coast by Johnson, Baird, Fewkes and others. A full list of these will be published in another connection.

*Diopatra californica* n. s. (Pl. XXXVII, figs. 1 to 9.)

This species probably attains a length of 200 mm., although the only complete example measures only 110 mm. long and 5 mm. wide at the termination of the region of long branchiæ. Prostomium small, mostly concealed by the bases of its appendages. Frontal tentacles nearly in contact at their bases, fusiform, nearly equal to the prostomium in length. Five principal tentacles similar in size, form and structure, arising in close contact from an arcuate area nearly covering the dorsum of the prostomium. The basal fourth of each forming a conspicuous ceratophore divided into twelve to fourteen rings equalling in length the head and frontal tentacles, the styles smooth, slender and tapering, apparently subequal, but the tips imperfect. Eyes, a pair of prominent, slightly pigmented swellings nearly in contact and occupying most of the region of the head posterior to the tentacles. Palps prominent, slightly bilobed processes bounding the mouth in front and in contact mesially.

Peristomium slightly shorter than the prostomium, which it embraces laterally. Nuchal tentacles on its extreme anterior margin, and in line with the outer edge of the inner lateral tentacles. The next two or three somites nearly equal the peristomium, and are rounded at the margins, while the remaining ones are much shorter, usually only about one-sixth or one-eighth of their width. For about the first fifth of the body through the branchial region they are much flattened, but beyond that become gradually rounded and taper toward the tail, which is terminated by a bead-like pygidium bearing near the middle line a pair of delicate ventral cirri having a length equal to the last eight or nine somites.

The first distinct parapodium is on the somite following the peristomium and consists of a setigerous body with three cirri, a postsetal lobe and a dorsal and ventral cirrus, all slender and conical and the latter about twice as long as the others. The second and third parapodia are similar, with the dorsal cirri longer. As far as the sixth or seventh the dorsal cirri continue to increase in length, then gradually diminish through the branchial region, and behind the latter remain small and slender to the end. The ventral cirrus undergoes no change in the first four parapodia, but suddenly disappears in the fifth, where it is represented by a small glandular prominence, which increases in size and in the middle branchial region extends about one-fourth of the distance across the venter. Beyond the branchial region it becomes smaller. The postsetal lobe is likewise largest on the first four somites, and after reduction in the first few branchial segments, accompanied by a rotation ventrad, remains for the entire middle region of the body a blunt, moderately sized lobe ventro-caudad of the setæ tuft. In the posterior half of the body all parts of the parapodia are reduced and finally become mere low papillæ.

In the region of their greatest development the branchiæ are large and prominent, of a tall and slender form, much like a juniper tree, but with the spirally disposed branches more open in arrangement and, below them a distinctly annulated basal portion of the trunk. They begin abruptly on the fourth parapodium, and the first is about three-fifths as long as the largest on the sixth or seventh parapodium. Beyond this point they gradually decrease in size, the number of whorls of branches at the same time increasing, and their arrangement becoming more open. By the twenty-seventh parapodium the spiral arrangement has disappeared altogether and the stem is simply curved, with the branches in a linear series on the convex side, an arrangement which begins to appear at the tip of some of the preceding gills, as though they were gradually unwinding. The number of turns in different branchiæ of the type is 11 on the first, 13 on the second, 15 on the third and fourth, 13 on the sixth, 10 on the tenth, 7 on the fifteenth, 4 on the twentieth, and none on the twenty-fifth. Beyond the thirtieth parapodium each gill consists merely of a stalk, usually curved at the free end and bearing a terminal tuft of short branches, with a few others in a series below. These gradually decrease in size, and by the fortieth parapodium are nearly or quite simple, and finally disappear by the sixtieth parapodium.

On the first four parapodia the setæ are of two kinds, guarded uncini and simple slender setæ. The former are nearly colorless and have

an incomplete transverse fracture or joint near the outer end and a strongly hooked tip with a stout subterminal spur; the guard extends somewhat beyond the terminal hook, and in the larger uncini at least reaches far down the shaft, along which its margin is distinctly free and denticulated. They are arranged in three groups, a ventral of two small and slender uncini (Pl. XXXVII, fig. 2), a middle of one large stout (Pl. XXXVII, fig. 1) and three to five smaller ones, and a dorsal group of one or two which are usually longer, especially in the end piece, than any of the others and intermediate in thickness. The more slender uncini, as shown in the ventral one figured, have the guards more prolonged. Of the simple setæ (Pl. XXXVII, fig. 3) there are but one or two in each foot, and they arise just dorsad of the posterior row of uncini, the longest one reaching nearly or quite to the tip of the posterior lobe and nearly equalling in diameter all but the very stoutest uncini. They are colorless, translucent, have barely visible oblique striations, become increasingly curved toward the tip, and when perfect are terminated by a small flexible filament.

On the tenth and succeeding parapodia the character of the setæ is altogether changed. There are no uncini, but in their place a spreading ventral vertical row of rather stout pale yellow strongly striated setæ, four to six in number, with the outer ends broadened, flattened and rather strongly curved and tapered to a very acute point (Pl. XXXVII, fig. 4). Dorsad of the postsetal lobe is a compact horizontal row of more numerous, longer, narrower and straighter setæ of otherwise similar form and structure. At the base of these, on the dorsal side, is a group of a few colorless spatulate setæ with slender stems and abruptly broadened fork-shaped ends with seven tines (Pl. XXXVII, fig. 5).

By the thirty-fifth parapodium the setæ are practically all confined to the horizontal dorsal fascicle and the spatulate setæ are more numerous, and have broader more curved plates with as many as nine rather spreading tines. Among them are also a few very small spatulate setæ with ovoid blade and simple mucronate tip. Posteriorly the setæ, especially the simple ones, are reduced in number, become more slender and project far beyond the now very small ventro-caudal lobe. By the seventy-fifth parapodium only about six such setæ remain, and the spatulate setæ have continued to widen and bear as many as eleven tines. Still further caudad the number of setæ is further reduced and they become more slender.

The four anterior parapodia are each supported by about three slender aciculi which enter the base of the dorsal cirrus, and the same

number of stouter ones in the setigerous lobe. A single hooked and guarded aciculus appears ventrally at about the tenth parapodium, and by the twenty-fifth there are two very stout ones (Pl. XXXVII, fig. 6), and above these a vertical row of four or five less stout but more opaque and deeply colored aciculi, whose ends project freely as acute points which increase in length dorsally where they pass into the regular series of setæ. Just beyond the point of their emergence is a slightly swollen deep brown spot, at which they readily break, indicating the existence of an imperfect joint (Pl. XXXVII, fig. 7). The arrangement just described continues to the seventy-fifth somite at least, and probably considerably beyond, but the one hundred and twenty-fifth has two hooked aciculi, only two pointed ones and a single simply bent and unguarded one (Pl. XXXVII, fig. 8).

The jaws (Pl. XXXVII, fig. 9) are nearly black and stout. The maxillæ have short, broad carriers, not united in the middle, and their bases bear two prominent tubercles. The next dorsal plate bears six or seven stout teeth, the next five on the left and seven on the right side, with a thin edentulous plate on each side. The extra plate on the left side bears seven or eight teeth. The mandibles have the terminal piece white and translucent, the carriers deep brown, loosely joined, very broadly rounded at the base and with a prominent longitudinal ridge.

***Eunice biannulata* n. s. (Pl. XXXVII, figs. 10-18; Pl. XXXVIII, fig. 42.)**

The type and largest example is 137 mm. long and 5.3 mm. between the tips of the parapodia at the widest point. The prostomium is short and broad, the length barely exceeding one-half the width, the anterior border scarcely emarginated, but the anterior lobes or palpi swelling broadly ventrad and laterad, and separated by a distinct median ventral furrow passing backward to the mouth, while a faint transverse groove separates a small anterior from a larger posterior portion. The tentacles arise in a nearly straight transverse line across the anterior portion of the white posterior half of the prostomium; the paired tentacles are in contact at their bases and are separated from the median tentacle by a distance about equalling the diameter of the latter. Ceratophores all very low and broad; styles constricted at the base, increasing gradually in diameter for one-fourth or one-fifth of their length and then tapering regularly to the end, simply articulated at the base, strongly beaded distally, the terminal joints caducous. The first joint is always much the longest, the second very short and often imperfectly differentiated, the others increasing in length more or less irregularly to the end, giving the impression of

a budding zone at the distal end of the basal segment. The type specimen, which has suffered less from maceration than the others, has the median tentacle with twenty-one articulations reaching to the middle of VI, the inner lateral thirteen articulations reaching IV, and the outer lateral seven articulations reaching II. Eyes black, somewhat elongated and crowded into the recess behind and between the bases of the lateral tentacles.

Peristomium considerably longer than the prostomium and slightly wider than its widest part, the anterior third distinctly separated dorsally as a ring which is sometimes elevated prominently above the head. The principal ring presents the usual lateral or mandibular lobes and a smooth unfurrowed ventral lip. The nuchal cirri have the characters of the tentacles, about equal the peristomium in length and have four to seven articulations. Somite II is very short, scarcely more than one-fourth of the prostomium, V is slightly enlarged, and behind it the remaining somites are of nearly uniform length until they begin to diminish at the posterior end. They are all smooth, simple and, especially in the branchial region, very clearly defined. A short cylindrical pygidium bears a pair of short stiff cirri and laterad of these, but still ventral to the anus, a pair of long, slender, flexible cirri equaling the fifteen terminal segments.

The first parapodium is strictly ventro-lateral; those following rise gradually to a half-way level. In form they undergo the changes usual in the genus, their chief characteristic being the prominence of the cirri, which are retained both dorsally and ventrally throughout the entire length of the worm. The dorsal cirri are especially prominent and distinctly articulated anteriorly where each consists of a larger basal and two smaller joints, together equalling the basal one. About XXV one of these disappears, and a little farther on the other, the cirrus at the same time becoming more slender, but remaining about twice as long as the setigerous lobe; posteriorly, as the latter becomes smaller, the cirrus is relatively much more slender, three or four times the length of the setigerous lobe, and often faintly articulated. The ventral cirrus also, while undergoing reduction in the middle region, exceeds the setigerous lobe throughout and always bears a small terminal joint.

The branchiæ are of typical uniserial pinnate form, the main stem curving mediad over the back and the end not being strongly bent upward. The branches are long, slender and simple but never exceed the dorsal cirri; they arise from the main stem at right angles, not dichotomously, and curve slightly mesiad. On two specimens they

have the following average distribution and complexity: Begin on V with one filament, 3 on VI, 5 or 6 on VII, 6 to 8 from VIII to XXX, 4 or 5 to XXIX, 3 to XLII, 2 to XLVI, 1 to LIV, and cease by LV.

The first parapodium (III) is supported by a pair of pale yellow, simple pointed, sharply bevelled aciculi (Pl. XXXVII, fig. 13), and bears a small number of ventral compound and dorsal capillary setæ, as well as one or two spatulate setæ. On IV the number of each kind, especially the last, is increased. By VI the typical number, size and arrangement is attained. The neuropodial aciculi are two or rarely three, stout and blunt, and in the case of one somewhat enlarged at the end (Pl. XXXVII, fig. 14). Between XL and L a single ventral crochet appears, and the dorsal aciculi become tapered and slightly curved at the end (Pl. XXXVII, fig. 15). The number of both compound and capillary setæ decreases in this region, and in the posterior somites the latter seem to be absent altogether. The compound setæ also undergo a slight alteration in form. The dorsal cirrus throughout is supported by about three slender aciculi.

The compound setæ (Pl. XXXVII, fig. 10) are all rather slender, nearly colorless, have curved, finely striated stems moderately enlarged at the ends; the appendix is not over two and one-half times the greatest diameter of the stem, the end is prominently hooked and bidentate, the accessory tooth distinctly triangular, guard narrow, scarcely covering the end. From the posterior branchial region caudad the hook gradually diminishes, while the accessory tooth increases in size, the base of the appendix becomes more oblique, and the end of the shaft more strongly curved and thicker (Pl. XXXVII, fig. 11). Throughout most of the branchial region the compound setæ are arranged in a nearly complete circle somewhat open both dorsally and ventrally.

The capillary setæ form a dense dorsal tuft reaching far beyond the compound setæ. They are pale greenish or nearly colorless, curved, finely pointed and faintly obliquely striated (Pl. XXXVII, fig. 12). Back as far as the end of the branchial region they exhibit a slight enlargement in the outer third, but posteriorly are strictly capillary. Spatulate setæ (Pl. XXXVIII, fig. 42) form a close dorsal tuft at the base of the capillary. They are colorless and very delicate, the ends half round with the outer angles prolonged and the distal margin folded and split into nine or ten processes tipped with short filaments which bend abruptly inward nearly at a right angle. These setæ appear as a single one or two in the first parapodium and continue to C at least.

The jaws (Pl. XXXVII, fig. 18) are delicate and nearly colorless, except in the thickest parts, which are brown. The maxillæ are slender, acute and at the base extend beyond the small carriers laterally. The basal dorsal plates have five or six teeth, and the much smaller anterior plates six and ten teeth on the left and right side respectively. The extra plate on the left side has six teeth.

Even in alcohol the colors of this species are well preserved and rich. The cuticle is everywhere smooth, polished and iridescent. For most of its length the body is beautifully annulated with a rich brown on a creamy-white ground. Each somite is marked on the dorsum with two narrow brown half rings separated from each other by an often impure area of the ground color, often divided by a narrow transverse brown line, and from the bands of the neighboring somites by a narrower, purer and more sharply defined intersegmental ring, also usually divided in the middle by a narrow transverse line. A dark median dorsal line is also often evident. The ventral colors are more obscure, but each somite in the anterior region has a dull brown cross-stripe. Farther back the stripes break into a paired series of spots replaced posteriorly by a series of narrow median spots, three on each segment, a very small one in the furrow, followed by a considerable interval, then a larger spot, a small interval and then the largest, an oval spot which extends over nearly one-half the length of the somite. The sides of the segments and, except anteriorly, the parapodia are colorless. For about the first ten somites the brown color becomes richer and nearly continuous on the dorsum, except that the somewhat enlarged fifth segment is pure white and conspicuous and the ninth is chiefly white. On the caudal region of the body the color approaches orange and becomes more suffused. Except for a row of minute dots about its dorsal posterior margin and a pair of larger spots at the base of the caudal cirri, the pygidium is white. The head is pale below with a brown spot in the ventral furrow; above its anterior half and a narrow median triangle extending from the base of the median tentacle to the posterior margin are brown, the rest pale. All of the tentacles, tentacular cirri and the anterior dorsal cirri are similarly colored; the ceratophore and all of the constrictions are brown, the enlargements white, resulting in a very sharply defined color annulation. The longer anal cirri are chiefly brown with white rings.

*Lumbriconereis erecta* n. s. (Pl. XXXVII, figs. 19 to 22; Pl. XXXVIII, figs. 23 to 25.)

The form and general aspect are about as usual in the genus, though the unusual length and prominence of the lobes of the posterior parapodia overcomes the trimness general to these worms. Full-grown

specimens are 300 mm. or more in length, and have a width of 3.5 mm. without and 5 mm. including the parapodia. The usual number of somites is about 330. The prostomium is sugar-loaf shaped in outline, slightly depressed, the length slightly exceeding the basal width, the apex narrowly rounded; at the base it is slightly mortised into the peristomium above and on the sides is marked by a pair of faint oblique grooves, in front of which are a few pigment spots but no distinct eyes; on the middle of the lower surface is a shallow median depression. Mouth large, bounded laterally by a pair of prominent L-shaped lobes connected with the peristomium, a much wrinkled fold of which bounds the mouth posteriorly. The peristomium is divided into two rings (perhaps somites) by a furrow which is very distinct above, obsolete below; the first ring equals the first setigerous somite, the second is two-thirds as long. Body nearly terete, very slightly depressed toward the ends; the somites all well marked, simple, smooth except for a very slightly raised welt around the middle; their length nearly uniform, from one-third to one-fifth their width, which is greatest at the middle. Toward the posterior end of the body there is a faint neural groove. The pygidium is a small platform ventral to the anus and provided with a pair of prominent short and thick bifid cirri, the median lobes of which come into contact in the median line.

In the middle region of the body the parapodia are situated about midway between the dorsal and ventral surfaces which are equally convex, but toward the ends they assume a lower level and the ventral surface becomes flattened. The parapodia (Pl. XXXVII, figs. 19-21) have a short, thick rounded base, a very small notopodial tubercle which receives four to six aciculi, a presetal lobe which is very short, thick and rounded throughout the series, and a prominent postsetal lobe which gradually increases in size from before backward, and in the middle and posterior regions has the form of a long finger-like process which generally bends abruptly upward at a right angle and rises above the back. The setæ are of the usually acute, winged and the hooded, hooked forms and vary greatly in details and particularly in the degree of curvature and geniculation. The anterior parapodia contain the acute type only (Pl. XXXVIII, figs. 23 and 24), at first in a somewhat broken fan-shaped tuft, but soon in a dorsal group of longer and middle and ventral groups of shorter setæ. At about XLV, guarded uncini (Pl. XXXVIII, fig. 25) appear in the ventral group, and by L are alone present to the number of four or five, which is further reduced to two or even one posteriorly. The ventral setæ of the dorsal bundle exhibit a reduction in size at about L, and by LX have given place

to uncini, but the slender setæ do not altogether disappear until about LXXV, from which point backward the uncini become stouter and the number gradually reduced to from one to three in each parapodium.

The jaws are coarse, black and very brittle. The mandibles (Pl. XXXVII, fig 22) are pale, stout and broad, with the two halves strongly united, especially by transverse striated bands across the end pieces. The bases are broad and roughly laminated.

Much of the original color has been lost, but the head and anterior region of the body retains a rich bronze with a beautiful blue and green iridescence; the posterior part is dull brown, due to heavy masses of pigment which are scattered everywhere through the deeper integument, but especially in a narrow transverse band and a pair of dorso-lateral spots on each somite.

***Cirratulus spirabranchus* n. s. (Pl. XXXVIII, figs. 26 and 27.)**

Form rather stout, thickest in middle and tapering almost equally both ways. The type is 105 mm. long and 5.5 mm. in diameter at the widest part. Prostomium elongated, pointed and slightly depressed, with a short oblique groove on each side above and near the union with the peristomium. No eyes visible. Peristomium enlarged, its length equal to six succeeding somites, somewhat irregularly divided into three or four rings of which the last is much longer than the others. There are about 300 setigerous somites, of which the first three or four are longer than the others. Nearly terete, but slightly flattened ventrally where the muscle coats are considerably thickened particularly toward the ends. All somites clearly marked, but short and uniannulate. The anus is a large dorsal slit reaching through 7 or 8 faintly marked somites and followed by a minute tubercle-like pygidium.

The branchiæ are numerous and crowded and usually more or less spirally coiled. They differ much in size, probably, however, only as a result of loss and regeneration, but their length does not exceed about five times the diameter of the body. Beginning with the first setigerous a pair occurs on every somite except the last thirty, arising immediately dorsad of the notopodial setæ or from the margin of the elevated band just above them. On the seventh setigerous somite occur the special branchiæ in a pair of dense tufts of about 20, arranged in two transverse rows which nearly meet medially. They are mostly smaller than the ordinary branchiæ, and owing to the crowding of this region usually appear to cover two somites, either VII and VIII or VIII and IX.

The setigerous tubercles (Pl. XXXVIII, figs. 26, 27) are separated by a smooth space about 3 or 4 times as broad as they, and both are

placed on a wide elevated band, the dorsal margin of which rises prominently about the notopodial tubercles and bears the branchiæ on its edge. The usual spines and capillary setæ are present, distributed as follows: Anterior to somite XL the latter only occur, but at XL or thereabout small, nearly colorless spines appear among the capillary bristles in the neuropodial fascicles; by L there are usually five, quite distinct and dark colored, though small; they alternate with the setæ, and as the latter diminish the former increase in number, the maximum of six being found from about C to CL, behind which the capillary setæ have nearly or quite disappeared, and the number of the spines becomes again reduced to four or five, a number which remains constant to the end, though further diminution in size occurs. In the notopodial fascicles the spines are smaller, slightly more numerous and first appear a little more caudad than in the ventral fascicles.

***Cirratulus luxuriosus* n. s. (Pl. XXXVIII, figs. 28 to 31.)**

Form slender throughout, thickest at about end of anterior third (somite C), tapering thence very gently to posterior end. The type and largest specimen is 110 mm. long and 4.5 mm. in diameter at somite C. In the best-preserved specimens the body is strongly convex above, concave below and angulated at the setæ levels, particularly the neuropodial. Prostomium about three-fifths as long as broad, rounded anteriorly, depressed, slightly retracted within the peristomium, grooved below in the middle line, thus leaving a pair of lateral palp-like thickenings which bound the mouth above; no eyes nor sensory slits apparent. Peristomium somewhat inflated, about twice as long as the prostomium and divided into two or three annuli. Setigerous annuli numerous (358 in the type), all very short and distinct, those of the posterior third rather longer and with faint indications of irregular division into two wings. The branchiæ form a conspicuous tangled mass, and even in the alcoholic specimens are very long, equalling ten times the diameter of the body but, unlike *C. spirabranchus*, exhibiting little tendency to coil spirally. They begin on the first setigerous somite in contact with the notopodia above, but continually rise to a higher level, until toward the posterior end they are much nearer to the dorsal middle line than to the setæ. To the 200th somite at least a pair of branchiæ occurs on every somite, but for the next 70 or 80 on every second, third or fourth somite only; there is no diminution in size posteriorly. The special branchiae are in a pair of close tufts crowded on the sides principally of the fourth setigerous somite. The number appears to be 12 or 14 on each side, but cannot be ascertained

with certainty. Anus rather small, nearly transverse, widely open and succeeded by a small median ventral tubercle.

The setigerous tubercles (Pl. XXXVIII, figs. 28 to 30) are very small, not elevated on any special muscular band, though appearing at the lateral angles posteriorly, and are well separated throughout. The first 30 somites bear capillary setæ only. Spines appear at that point in the ventral fascicle and soon become thick and dark brown. By XL there are usually four of these spines associated with capillary setæ, but the number soon becomes reduced to three, the number of capillary setæ simultaneously diminishing. From CXX to CL there are two spines and the capillary setæ have disappeared; beyond CL there is one (or rarely two) large, stout, nearly black spine which continues to increase gradually in size. Toward the posterior end a reverse change begins, and behind CCC there are usually two comparatively slender and pale spines. In the notopodial fascicles spines appear later, the first at about L. At about C three small pale spines usually occur, with the capillary setæ. The fascicles undergo changes analogous to those just described, but in the same segment the spines are almost always more numerous, not over one-third as large and always associated with capillary setæ.

*Maldane disparidentata* n. s. (Pl. XXXVIII, figs. 28 to 31.)

The length of complete examples is from 100 to 150 mm., and 4 to 6 mm. in diameter in the somewhat contracted state; some fragments indicate specimens of larger size. Probably owing in part to contraction, as indicated by a distinct fold of the first setigerous somite which overlaps the head ventrally, the latter is truncated with little obliquity; its ventral length, including the united prostomium and peristomium, is scarcely one-third more than the dorsal. Cephalic plate broadly oblong-elliptical, its width at least four-fifths its length, the surface smooth and slightly elevated in the center. The frontal ridge low, broad and inconspicuous; beginning just anterior to this elevation and ending anteriorly in the palpode; its length equal to one-third the cephalic plate; posteriorly one-third as wide as the plate, gradually widening for its posterior half, then suddenly expanding into the palpode which is broad, thick, rounded, smooth and separated from the cephalic margin laterally by only a slight emargination. Sensory slits short, sharply defined but inconspicuous. Cephalic margin nowhere much produced, low and thick, probably in part the result of contraction; a pair of lateral clefts divide the posterior one-third from the anterior two-thirds. The former is lower, embraces the latter at the sides and has its margin divided into about fifteen low, broad, truncate teeth,

very irregular and inconstant in different individuals, but always diminishing in size and distinctness toward the posterior middle line and often grouped in pairs. The lateral lobes, which reach forward to the palpode, are considerably more elevated and bear five or six larger, more prominent, rounded teeth. The mouth is a conspicuous opening bounded behind by a transverse fold and laterally by distinct thickened lobes. Behind it is a distinct peristomial half-ring rendered more conspicuous by contraction.

There are nineteen setigerous somites, the first seven thick-walled and largely glandular, the first six strongly biannulate with the anterior ring larger and setigerous. This region is usually slightly depressed with each of the first six somites about as long as wide, but the unianular seventh only equalling the larger anterior ring of the others. Behind VIII the somites increase gradually in length and become somewhat narrower to XVI, which is three times as long as wide; XVIII, XIX and XX become successively shorter. From the eighth to the nineteenth inclusive the parapodia are posterior in position, and the more anterior are situated on complete glandular zones which soon become incomplete and restricted to the lateral faces of the somites. Distinct constrictions occur at the intermetameric furrows which are rendered much more conspicuous by the prominent tori preceding them. The surface of all somites is more or less annularly furrowed and bears numerous small glandular and sensory papillæ. The last somite (XXI) bears no setæ and is smooth and uniannulated. Caudally it enlarges and passes gradually into the anal funnel, dorsad of which the anus is situated behind a somewhat wrinkled anterior fold. The anal funnel consists of two parts, the ventral funnel proper, the cavity of which reaches to the anterior end of the anal segment while the margin is even and not at all flaring, and the dorsal platform, which arises within the dorsal part of the ventral funnel and spreads in a flat, broad petaloid form vertically behind the anus. The margins of both parts are slightly irregular, but entirely without lobes or processes.

On the anterior somites the parapodia are strictly lateral, on the posterior ventro-lateral and more prominent. Somite II bears setæ alone, III to XX both dorsal setæ and ventral uncini. The setæ are of three forms which, however, vary and intergrade. The several kinds arise in more or less distinct fascicles, but spread in such a manner that they appear at the surface in pairs or triplets composed of one of each kind; thus on II they form a fan-shaped figure of about 25 pairs, on III about 15, on IV 12, on V 10 and a more irregular arrangement in triples on the abdominal segments. Slender capillary wingless

setæ, rather abruptly attenuated at the surface of the body wall, occur in all setigerous somites. The anterior ones project about one-third as far as the larger setæ, but in the posterior segments they become much longer and filamentous. Winged setæ also occur in all somites. They are about three or four times the diameter of the smaller ones in their exposed parts and quite deeply colored, nearly straight, tapered to an acute tip, broadly winged on one margin and very slightly on the other. The stoutest ones occur in the posterior thoracic somites, where also setæ of intermediate form are present, some of the smaller ones having short basal wings. In the abdominal bundles most of the larger setæ are provided with delicate doubly spirally fringed tips (Pl. XXXVIII, fig. 35) which differ considerably in length, the longest in the middle abdominal region forming more than one-half of the exposed portion. Posteriorly the number of setæ is reduced, the filamentous ones predominating.

The uncini are all rather stout and of a deep yellow color; 7 or 8 occur on III, about 10 on V, and about 35 on VIII and the following somites. On somites III to V the uncini have the form shown in Pl. XXXVIII, fig. 32. The stems are very slightly curved, strongly striated and have a scarcely perceptible shoulder; the heads are but little enlarged with a blunt pointed beak bent at an angle of  $100^{\circ}$  to  $120^{\circ}$ ; a crest composed of two rows of teeth, the anterior with a few large teeth in the middle, the posterior and lateral smaller, and a simple guard of about 12 spreading hairs ending at the tip of the beak. On the remaining somites the crochets form a much longer row and have the stems more curved, the shoulder larger, the head more expanded, the beak much longer, more acute, much more strongly hooked at an acute angle, the crest more elevated, with the smaller teeth in more numerous rows and more closely embracing the base of the beak, and the guard arising from a distinct flange below a re-entering angle (Pl. XXXVIII, fig. 33).

This species is represented by a large number of examples.

**Terebella (Schmardanella) californica n. s. (Pl. XXXVIII, figs. 36, 37.)**

This species has the general aspect of *Amphitrite spiralis* Johnson, from which it is readily separated by the much smaller number of setigerous somites in addition to other characters. The type measures 75 mm. from the pygidium to the tip of the prostomium, but another less perfect specimen is nearly twice as large; the diameter at X is 3.3 mm. The prostomium is prominent, little arched, projects forward and is faintly trilobed its margin slightly revolute and its lateral por-

tion distinctly reflexed. Eyes absent. Tentacles very numerous, deeply grooved, arising from the posterior border of the prostomium for its entire width in three or four transverse crowded rows, behind which is a slightly elevated border. Most of the tentacles are colorless, but usually some are pale brown. Mouth large with a broad peristomial lower lip. Peristomium about as long as succeeding somites, distinctly visible as a ring both above and below.

Branchiæ two pairs on the posterior part of somites II and III, the first just anterior to the first setæ tuft, the second above and behind it. All of the branchiæ are prominent, and of about equal size. They are of a spreading bushy form; the main stem very short, dichotomy occurring almost immediately and the outermost branch again dividing at once, so that three main branches appear to arise almost separately. After about four or five dichotomous divisions, which are usually unequal, one or two irregular divisions occur, the result being a very large number of terminal twigs. When contracted the minor divisions coil inward toward the axis, so that the gill presents a very compact appearance. There is, however, much irregularity in this respect, some of the filaments merely shortening, others coiling spirally.

The body is slender and club-shaped, nearly terete throughout the abdominal region, gently tapered to the anus and the anterior end of the thorax somewhat enlarged. The thoracic segments increase slightly in diameter to about X, and then decrease very gradually into the abdominal region. The dorsum is regularly arched, the venter somewhat angulated, flattened or slightly convex, according to the state of the specimen. Above the somites are somewhat indistinctly separated and somewhat irregularly divided into three rings which are usually again biannulate. On the ventral half the intersegmental furrows are well marked and the somites only biannulated. This region is also rough and thickened, and separated from the faintly granulated, thin-walled dorsal region by a longitudinal groove below which is a ridge-like row of glandular thickenings. The first one or two ventral plates are very short. They increase in length to the tenth, and in width decrease regularly and gradually to the sixteenth, which is square, while the tenth is twice, and the fifth three times as wide as long. Usually a cross-furrow divides each one and the surface is wrinkled. On most specimens the fifth or sixth plate is sunken below the general surface. Behind the sixteenth they become very small, but may be traced for some distance further. The thorax passes very gradually into the abdomen, which is very prominently arched and thin-walled, the somites numerously and finely ringed and indistinctly

separated from one another. At the posterior end the metamerism becomes obscure and the pygidium is truncated.

Throughout the thoracic and much of the abdominal region the uncinigerous tori are prominent. They begin on V, increase in length to about XIII, remain practically uniform to about XX, and then very gradually diminish, the last thoracic being about equal to the seventh. As they become smaller and the ventral plates narrower, the tori are carried more and more to the ventral surface, until in the middle abdominal region they form bead-like swellings on a pair of muscular ridges separated by a narrow median groove. Toward the posterior end they are barely recognizable. Setigerous tubercles begin on IV, and continue for from twenty-three to twenty-eight somites, twenty-six being the most frequent number. They stand out prominently from the dorsal end of the tori, especially the anterior ones, which bear the greatest number of setæ. Whitish glandular thickenings occur just dorsad of the setæ lobes as far as somite XXII and prominent nephridial papillæ from VII to XX inclusive, and less prominently and regularly on some of the succeeding somites.

The setæ (Pl. XXXVIII, fig. 36) are noteworthy for the prominence of their pennant-like fringed tips. They are arranged as a single row of larger ones flanked on one or both sides by a row of smaller setæ. The former are straight or slightly curved, with about one-half of the exposed portion included in a loose sheath beginning abruptly and tapering to the terminal pennant which begins as a sudden, much flattened, very thin angulated expansion, curved strongly to one side, tapered to a delicate point and prominently fringed on one margin. The smaller setæ are little more than one-half as thick as their exposed parts, only half as long as the larger. Their form is generally similar, but the sheath is less evident and the tips broader, longer and more abruptly bent to one side. Setæ of the first tuft are more slender and of the posterior ones fewer than elsewhere.

The uncini (Pl. XXXVIII, fig. 37) are biserial and opposite on XI and all following somites; uniserial on those anterior to XI. They have a rather short base strongly convex below with a prominent toe, a small posterior ligament process and a subrostral process with a guard; the sinus is narrow with subparallel sides, the beak long, acute and strongly hooked and the crest prominent, elevated and composed of three or four transverse tooth rows, the lowermost large. On the posterior somites the uncini are small, lack the posterior ligament process and are consequently less angulated and they have a larger number of teeth in the crest.

*Distylium rugosa* n. s. (Pl. XXXVIII, figs. 38 to 41.)

This is a large, handsome species, somewhat resembling *Bispira polymorpha* Johnson, but differing from that species in the fewer spiral turns of the branchial base, the greater number of branchial radioles, the arrangement of the eyes, the form of the spatulate thoracic setæ and pick-shaped uncini and probably the deep rugous dorsal folds.

Exclusive of the branchiæ, the type is 67 mm. long, the width at the posterior end of the thorax to the middle abdominal region being 8 mm. and the depth at the same points 6 and 5 mm. respectively. The ventral ends of the stiff, cartilage-like branchial bases are prolonged and spirally coiled, but make only  $1\frac{1}{4}$  turns. The radioles, which reach a length of 22 mm. at the dorsal and somewhat less at the ventral end of the series, arise to the number of 58 on the left, 55 on the right, in a crowded, closely interlocking double row from the entire distal margin of the basal lobes. Each is strictly simple and perfectly free from the others to the base; the outer surface is rounded and the inner bears the numerous barbs, which have a length about twice the diameter of the radiole, in a crowded double series for its entire length except a short naked terminal region. In this species the eyes are less perfect but far more numerous than in *D. polymorpha*, the number on each radiole approximating 100. They are very irregularly distributed in groups on both margins, most plentifully on the distal half, where a very constant group of large eye-spots occurs just proximad of the naked tip. In the type the branchiæ are pale-colored, each plume with three brown spots, one near the base and two in the outer half; the other specimen has the gills almost continuously pale reddish-brown mottled with white, especially on the basal half. The palpal membrane has a free margin completely encircling the bases of the branchial radioles within. It extends around the sides of the mouth, ventrad to which the two halves meet as a pair of vertical plates contiguous to the middle line, and entering the ventral collar incision partly join the somewhat swollen bases of the ventral collar lobes. The tentacles are about as long as the basal branchial lobes, and have the basal half broadly margined, the distal half filamentous.

The collar is rather thick, stiff, flaring and prominent throughout its extent. The dorsal opening is equal to nearly  $\frac{1}{2}$  the body width at the peristomium, with the broadly rounded dorsal lobes bounding it slightly, curving around the dorsal side of the first pair of setæ fascicles, but free from them. The ventral opening is narrow but deep and, as mentioned above, is partly occupied by the ventral prolongations of the circumoral membrane; on each side of it are the short, broad and

thick ventral lobes. There is a pair of slight lateral emarginations, but no well-marked incisions.

Except at the rounded peristomium the body is depressed. It increases in width to the end of the thorax, from which point it diminishes very gently to the posterior one-tenth or beyond, and then very rapidly to the small pygidium, on each side of which is a conspicuous cluster of numerous brown pigmented eye-spots. There are 8 setigerous thoracic and 107 abdominal segments. The coalesced peristomium and first setigerous somite are about twice as long as succeeding somites. Besides the collar they bear an undivided, very thick ventral plate, which is about twice as long and much wider than any succeeding thoracic plate, but about equal in the latter respect to the first abdominal. The remaining thoracic plates are about equal in length, but from the third, which is the narrowest, they increase gradually in width to the last. Owing to lateral extensions anterior to the uncinigerous tori, the margins of the ventral plates are strongly serrated. The abdominal ventral plates are also thick and occupy about three-fifths of the ventral area. Widest at the anterior end, the first 15 or 20 become gradually narrower, after which there is no change until at the posterior end of the body they diminish correspondingly. Throughout they are sharply defined by straight margins. In the alcoholic specimens all of the segments are short and sharply defined, and an extensive area on the dorsal surface is thrown into very deep rugous glandular folds, occupying on the posterior one-third of the type specimen the entire width of the dorsal area, but anteriorly becoming lower and more and more restricted to the middle region until they finally fade out. On the second specimen they are less conspicuously developed, but are otherwise similar. A well-marked faecal groove divides the abdominal ventral plates into equal halves to the first, cuts this obliquely to the left and passes dorsad in the thoracico-abdominal groove to the level of the abdominal setæ tufts, and then obliquely across the last thoracic somite dorsal to its setæ tuft to the middle line, along which it proceeds as a deep and conspicuous groove to the dorsal collar opening.

All setæ tufts are large and prominent, the abdominal strictly vertical and ventral, the thoracic dorsal and slightly oblique, except the first, which is nearly horizontal, entirely free from the collar and slightly smaller than the others. The uncinigerous tori are also well marked, on the thoracic somites meeting the ventral plates below and slightly hooked backward above. The first pair, on the second setigerous somite, are the longest; the seventh and last about three-fourths as

long; reduction in length takes place at both ends and the setæ tufts descend to a correspondingly lower level. All abdominal tori are shorter than the last thoracic and they diminish gradually and constantly to the posterior end. They are especially prominent dorsally where they terminate in a prominent projection marked with a conspicuous black spot.

All setæ are nearly colorless, translucent and striated. Those of the first or collar fascicle are all of one form, slender, narrowly lanceolate, slightly curved and with a single narrow wing, but differ considerably in length. On other thoracic somites those in the dorsal rows of the bundles are similar (Pl. XXXVIII, fig. 38), but the ventral ones (Pl. XXXVIII, fig. 39) are shorter, spatulate, doubly winged, and have acute but not mucronate tips; they differ somewhat in curvature and breadth of wings, but the one figured is typical. The abdominal setæ are again all of one kind, rather more broadly lanceolate than, but otherwise similar to, those of the collar fascicle.

The thoracic uncini are of two kinds—large aviculæ and smaller pick-shaped hooks, arranged in opposed parallel rows, there being 105 of each on II, 97 on V, and 90 on VIII on the type specimen. The aviculæ (Pl. XXXVIII, fig. 40) are of a very pale yellow, the bases long, slender, slightly curved; the neck and head prominent and erect, slightly inclined forward; the breast prominent, hemispherical; the neck slightly tapered and about as long as thick at the base, the head scarcely enlarged with the rather stout but acute beak strongly bent downward, the crest little elevated and forming a dense sheath of fine spines arranged in numerous transverse and longitudinal rows closely appressed on the upper half of the beak. Abdominal aviculæ differ only in their somewhat shorter bases and less prominent breasts. They are not associated with pick-shaped uncini and the type specimen has about 80 in each torus.

The pick-shaped uncini (Pl. XXXVIII, fig. 41) have stems about as long as the bases of the aviculæ, but much more slender; they are nearly straight, but more or less slightly enlarged and bent at about the beginning of the outer one-third. The tip curves to a short blunt point enclosed within a loose expanded hood, from which arises a delicate, colorless, very slender process, making an angle of about 60° with the stem.

Except as already described for the branchiæ, all pigment has faded out. *Distylia* Quatrefages is employed instead of the earlier *Bispira* Kroyer, because the author of the latter seems never to have applied the name to any species.

## EXPLANATION OF PLATES.

## PLATE XXXVII.

*Diopatra californica*, Figs. 1 to 9.

- Fig. 1.—Large guarded and hooked seta from the middle of the third parapodium.  $\times 250$ .  
 Fig. 2.—Small one from ventral bundle of the same.  $\times 250$ .  
 Fig. 3.—Simple slender seta from the same.  $\times 250$ .  
 Fig. 4.—Broader winged seta from the tenth parapodium.  $\times 250$ .  
 Fig. 5.—Spatulate and pectinate seta from the same.  $\times 440$ .  
 Fig. 6.—Crochet-shaped aciculus from the twenty-fifth parapodium.  $\times 250$ .  
 Fig. 7.—Simple pointed aciculus from L.  $\times 250$ .  
 Fig. 8.—Simple blunt aciculus from LXXV.  $\times 250$ .  
 Fig. 9.—Jaws, all parts in dorsal view; on the left the maxillæ are shown *in situ*, on the right the plates are separated.  $\times 8$ .

*Eunice biannulata*, figs. 10 to 18.

- Fig. 10.—Compound seta from second parapodium.  $\times 250$ .  
 Fig. 11.—Compound seta from somite LXX.  $\times 250$ .  
 Fig. 12.—Slender seta from second parapodium.  $\times 250$ .  
 Fig. 13.—Pointed aciculus from the first parapodium.  $\times 250$ .  
 Fig. 14.—Flattened aciculus from X.  $\times 250$ .  
 Fig. 15.—Dorsal aciculus from LXV.  $\times 250$ .  
 Fig. 16.—Dorsal aciculus from LXX.  $\times 250$ .  
 Fig. 17.—Hooked and guarded ventral aciculus from LXV.  $\times 250$ .  
 Fig. 18.—Dissected jaws viewed from above.  $\times 12$ .

*Lumbriconereis erecta*, figs. 19 to 22.

- Figs. 19, 20, and 21.—Anterior views of the 10th, 100th and 250th parapodia respectively.  $\times 33$ .  
 Fig. 22.—Mandible.  $\times 8$ .

## PLATE XXXVIII.

*Lumbriconereis erecta*, figs. 23 to 25.

- Figs. 23 and 24.—Slender winged seta from the 10th and 25th parapodia respectively.  $\times 130$ .  
 Fig. 25.—Hooded crochet from middle of the 10th parapodium.  $\times 250$ .

*Cirratulus spirabranchus*, figs. 26 and 27.

- Fig. 26.—Outline of side of 50th setigerous somite.  $\times 24$ .  
 Fig. 27.—Same of 150th setigerous somite.  $\times 24$ . *a*, ventral, and *b*, dorsal spine.  $\times 55$ .

*Cirratulus luxuriosus*, figs. 28 to 31.

- Fig. 28.—Outline of side of 50th setigerous somite.  $\times 24$ .  
 Fig. 29.—Outline of side of 150th setigerous somite.  $\times 24$ .  
 Fig. 30.—Outline of side of 150th setigerous somite.  $\times 24$ .  
 Fig. 31.—A spine from the ventral bundle of the 50th somite.  $\times 55$ .

*Maldane disparidentata*, figs. 32 to 35.

- Fig. 32.—Outer end of a crochet from the 2d setigerous somite.  $\times 250$ .  
 Fig. 33.—Outer end of a crochet from the 14th setigerous somite.  $\times 250$ .  
 Fig. 34.—Front view of the last.  $\times 250$ .  
 Fig. 35.—Portion of a spirally fringed seta from the 14th somite.  $\times 440$ .

*Schmardanella californica*, figs. 36 and 37.

- Fig. 36.—A seta from somite XI.  $\times 600$ .  
Fig. 37.—An uncinus from the same somite.  $\times 600$ .

*Distyliia rugosa*, figs. 38 to 41.

- Fig. 38.—Slender seta from dorsal part of VI.  $\times 250$ .  
Fig. 39.—Broad seta from ventral part of VI.  $\times 250$ .  
Fig. 40.—Avicular uncinus from VI.  $\times 250$ .  
Fig. 41.—Pick-shaped uncinus from VI.  $\times 440$ .  
Fig. 42.—*Eunice biannulata*. A spatulate and pectinate seta from a middle parapodium.  $\times 440$ .



